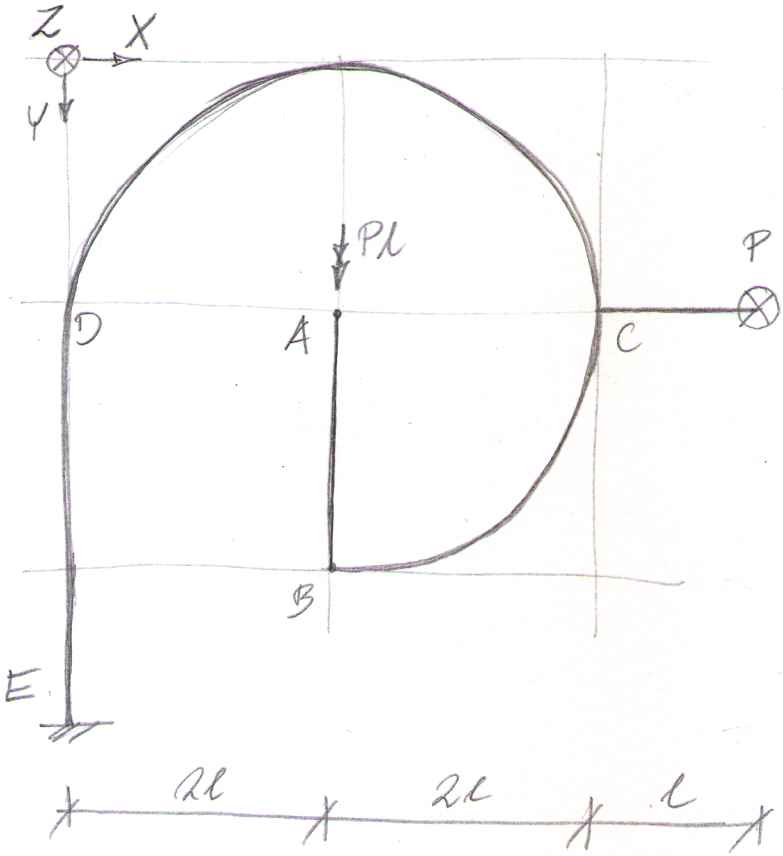


$EJ = GJ_S$

$W_A = ?$

$\int \sin x\,dx = -\cos x$

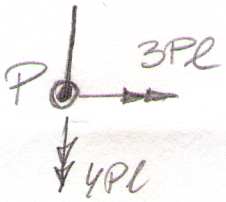
$\int \cos x\,dx = \sin x$

$\int \sin^2 x\,dx = \frac{1}{2}(x - \sin x \cos x)$

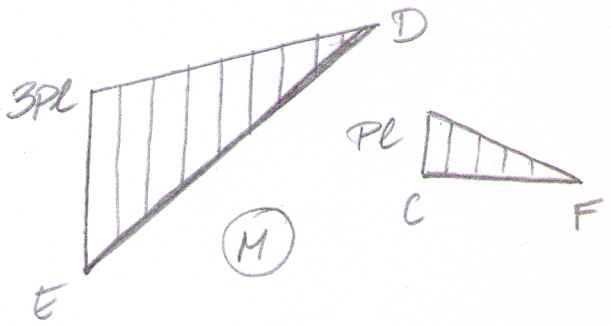
$\int \cos^2 x\,dx = \frac{1}{2}(x + \sin x \cos x)$

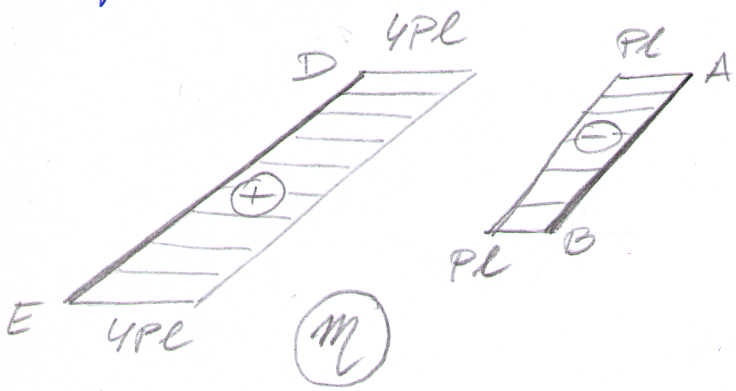
$\int \sin x \cos x\,dx = -\frac{1}{2}\cos^2 x$

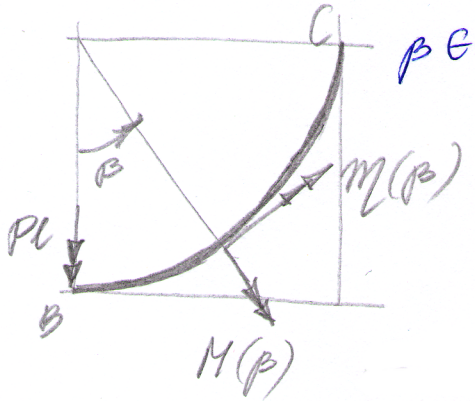
Reakcje w podporze:



Momenty od sił zewnętrznych (tam, gdzie są niewygodne):



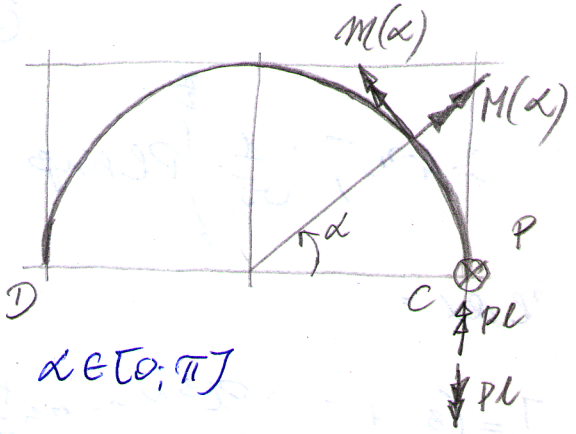




$\beta \in [0; \frac{\pi}{2}]$

$M(\beta) + Pl\cos\beta = 0 \Rightarrow \underline{M(\beta) = -Pl\cos\beta}$

$N(\beta) - Pl\sin\beta = 0 \Rightarrow N(\beta) = Pl\sin\beta$



$\alpha \in [0; \pi]$

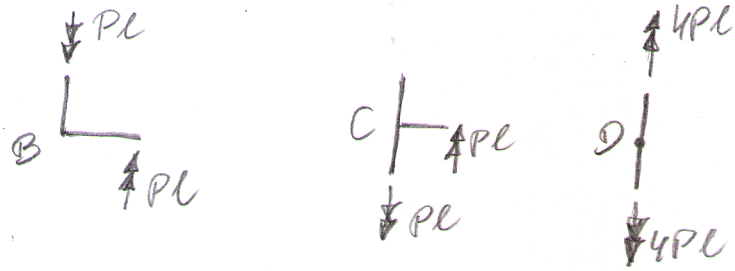
$M(\alpha) + P \cdot 2l \sin\alpha = 0$

$\underline{M(\alpha) = -2Pl\sin\alpha}$

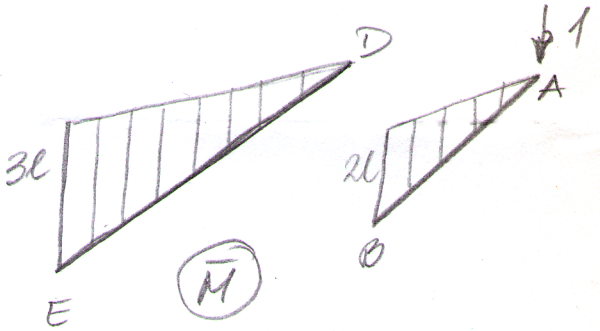
$m(\alpha) - P \cdot 2l(1-\cos\alpha) = 0$

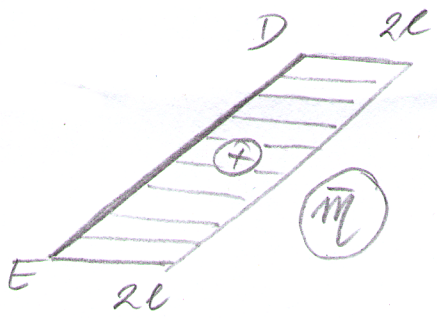
$\underline{m(\alpha) = 2Pl(1-\cos\alpha)}$

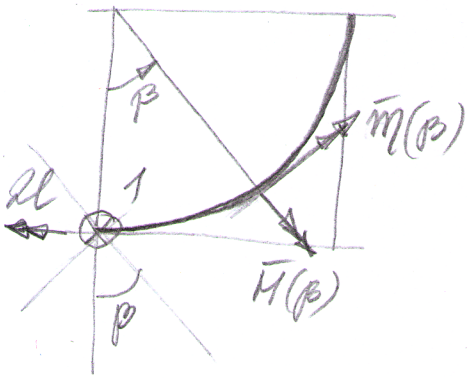
Sprawdzenia:



Momenty od obciążenia jednostkowego przyłożonego w miejscu szukanego przemieszczenia:

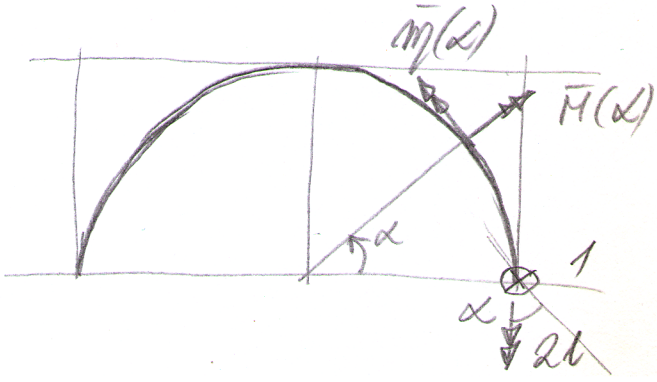






$\bar{M}(\beta) + 2l\sin\beta - 2l\sin\beta = 0 \Rightarrow \underline{\bar{M}(\beta) = 0}$

$\bar{m}(\beta) - 2l(1-\cos\beta) - 2l\cos\beta = 0 \Rightarrow \underline{\bar{m}(\beta) = 2l}$



$\bar{M}(\alpha) + 1 \cdot 2l\sin\alpha - 2l\sin\alpha = 0 \Rightarrow \underline{\bar{M}(\alpha) = 0}$

$\bar{m}(\alpha) - 1 \cdot 2l(1-\cos\alpha) - 2l\cos\alpha = 0$

$\underline{\bar{m}(\alpha) = 2l}$

Znajdowanie W_A:

$$W_A = \frac{1}{EJ}\left[\frac{1}{2}\cdot 3l\cdot 3l\cdot\frac{2}{3}\cdot 3Pl\right] + \frac{1}{GJ_s}\left[2l\cdot 3l\cdot 4Pl\right] + \frac{1}{GJ_s}\int_0^{\frac{\pi}{2}} Pl\sin\beta\; 2l\cdot 2l\, d\beta + \frac{1}{GJ_s}\int_0^{\pi} 2Pl(1-\cos\alpha)\cdot 2l\cdot 2l\, d\alpha =$$

$$= \frac{1}{EJ}\left[9Pl^3 + 24Pl^3 + 4Pl^3 + 8\pi Pl^3\right] = (37+8\pi)\frac{Pl^3}{EJ} \approx 62{,}133\frac{Pl^3}{EJ}$$